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Fig. 1. Exhibition Hall No. 7. Leipzig Fair. Biggest Hall in Europe with unsupported Roof Girders.
Span 328 ft. Length 459 ft. Erected in 1928.

M·A·N

MASCHINENFABRIK AUGSBURG-NÜRNBERG A-G

STEEL STRUCTURES

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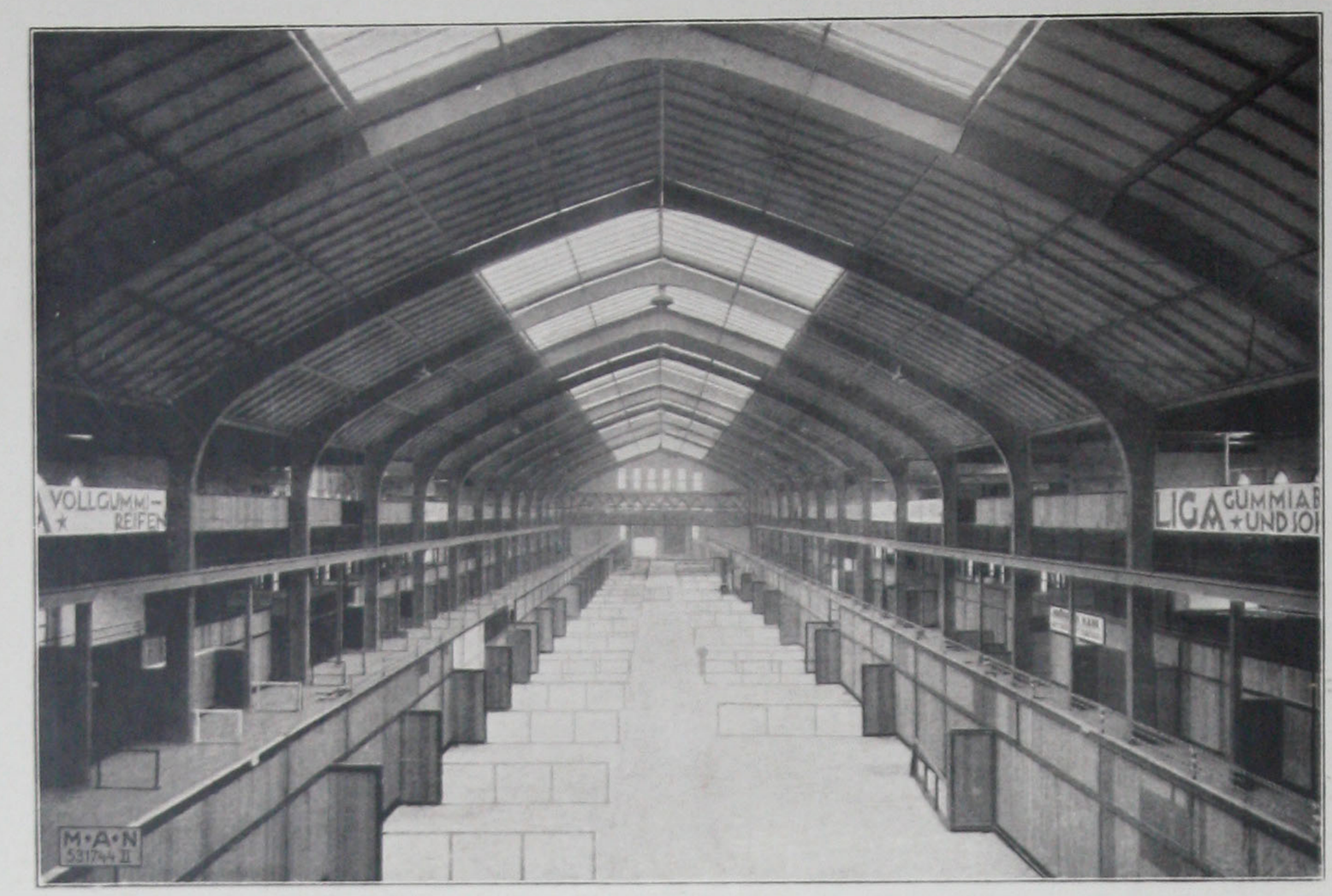


Fig. 2.
"Haus der Technik"
Frankfort-on-Main Exhibition
Erected in 1921/22. View of
the large middle hall.

In the extraordinary development in structural steelwork during the last decade the influence of the Maschinenfabrik Augsburg-Nuernberg A. G. (abbreviated M. A. N.) has perhaps been one of the largest factors. In 1854 the old Nuernberg Works had already caused a sensation by erecting the Crystal Palace in Munich within 100 days. Whilst building a bridge over the Rhine, M. A. N. established a Works at Gustavsburg (near Mainz) to which all structural steelwork was subsequently moved. These Works soon became famous.

For the first time engineers and architects working in systematic and scientific co-operation created the "Gustavsburg" style. This co-ordination is now followed by M. A. N. for present day structures, and the results surpass all other efforts in open competitions. To-day the M. A. N. is among the leading structural steel works of the World.

Fig. 3. Festival and Exhibition Hall Frankfort-on-Main. Area 7176 sq. yards., seating accommodation 12,000, standing accommodation 6,000. Erected in 1907/08.

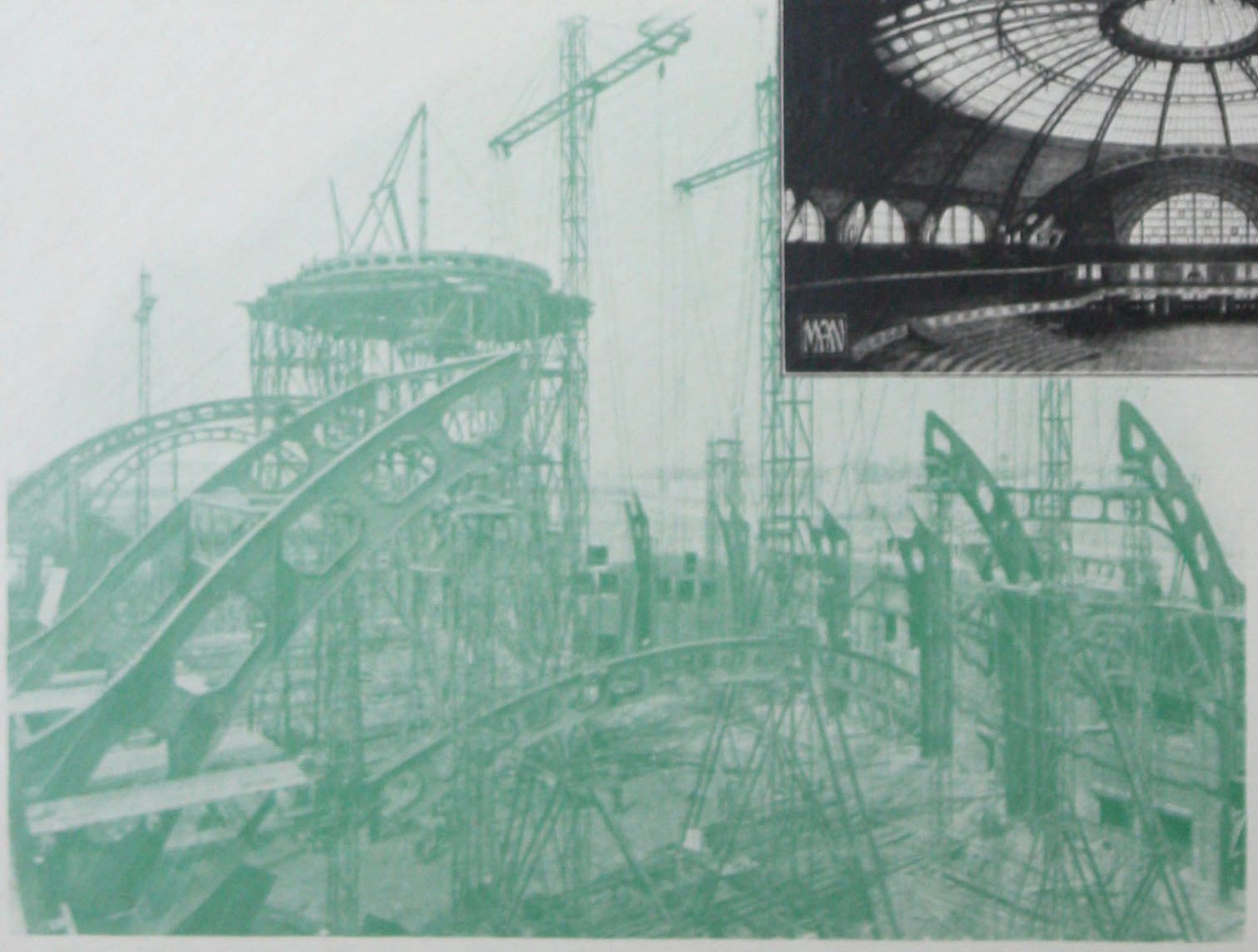


Fig. 4.
Erection of the Frankfort-on-Main Festival Hall.

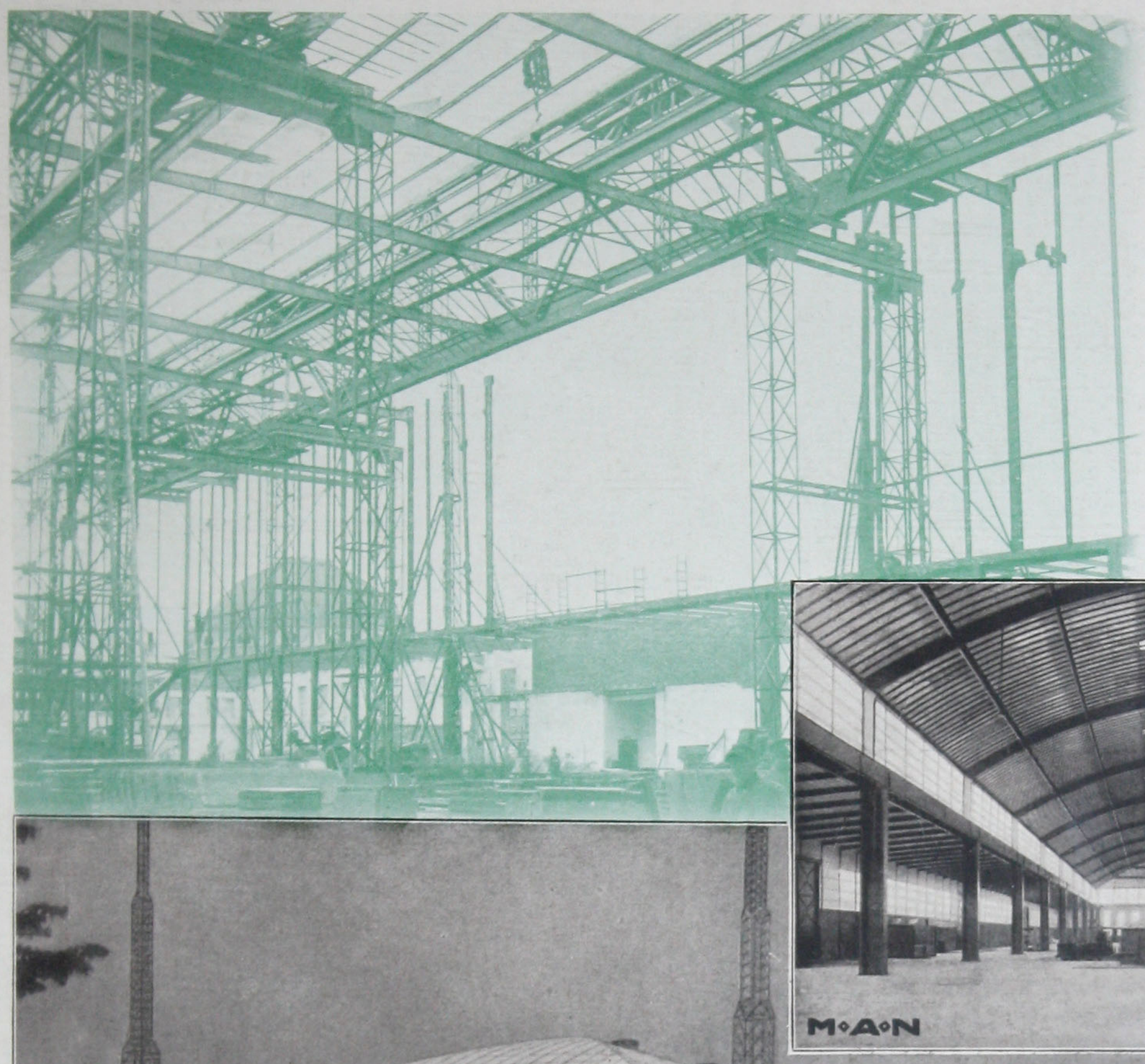


Fig. 5. Hall No. 7 Leipzig Fair, during erection.

Fig. 6. Hall No. 21. Leipzig Fair (Engine Exhibition Hall). Length 508 ft. 6 ins. Area 8,133 sq. yds.

Large Public Buildings.

The happy blending of the practical and artistic side is mostly seen in the large halls and buildings of public life. The Gustavsburg Works have built a number of banquet and exhibition halls of various types. The magnificent dome-shaped building of the Frankfurt Festival Hall is a characteristic example. Its daring girder work in the form of huge curved girders of the highest artistic merit but peculiar simplicity nevertheless embody the utmost practical efficiency. Again there are the light fairylike arches of the Technical and Fashions Hall of the Frankfurt Exhibition and Exhibition Hall Nr. 21 of Leipzig. Hall Nr. 7 of the Leipzig Fair shows quite another modern development where the roof girders are incorporated in the roof by such unique and ingenious methods that they can hardly be seen. In this way an unsurpassably spacious effect is obtained. It is the largest unsupported roof in Europe, and has a span of 328 ft. The erection was completed within 7 weeks despite severe winter conditions.

Railways and modern aircraft also need halls of the largest dimensions with either huge single vault spans or several continuous roofs of smaller span. Examples of various types are the halls in Metz, Basel, Karlsruhe, Homburg, Bangkok etc. Large goods sheds were supplied to Basel, Freiburg and Leipzig. The same girder design used for the Leipzig Exhibition Hall No. 7

Fig. 7.
Railway Station Hall, Metz,
area 28,700 sq. yds.,
total weight of steel structure 7,200 tons.,
erected in 1909/10.

Fig. 8. Railway Station Hall, Homburg v. d. Höhe

is employed for the large garage of the Dresden Co-operative Society and for two cotton stores in the New Bremen Harbour which cover a total area of 494,000 sq. ft. The special designs for revolving airship sheds originally evolved by M. A. N., form the very valuable basis on which the prospective developments for the air traffic of the World are founded. Quite peculiar problems are involved for theatres and stages with their dome shaped and ring designs, adjustable stages and trap doors. Here the M. A. N. applied their wide experience in the manufacture of conveying plant and hydraulic installations. Large stage structures were erected at Nuernberg, Freiburg, Dresden, Mexico City, Wiesbaden, Sofia and more recently for Angora, as well as the Oberammergau passion plays.

The erection of very high buildings (skyscrapers) introduced a new working field for the structural steel designer. Only by its supporting skeleton of structural steelwork have buildings

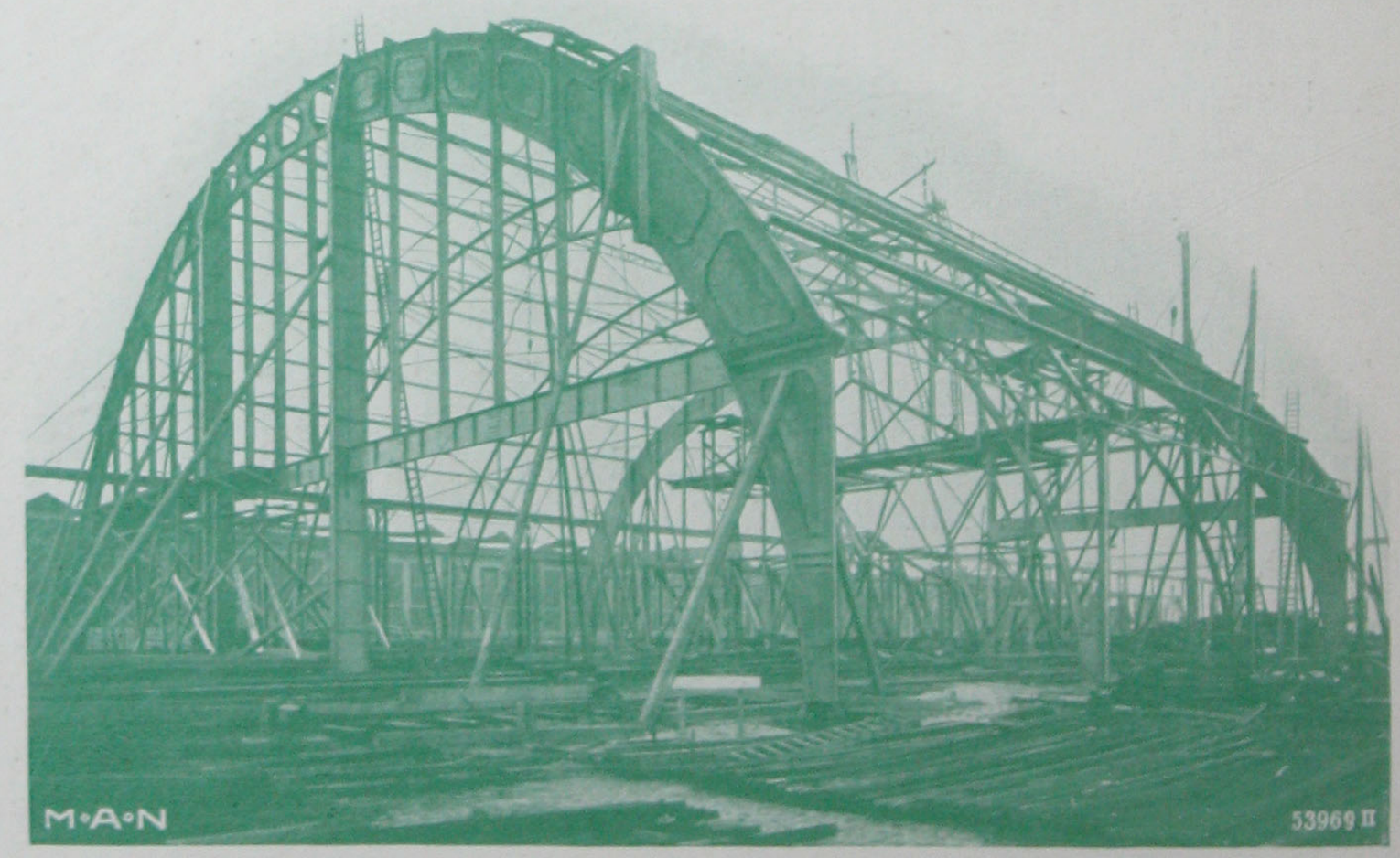


Fig. 9. Railway Station Hall,
Bangkok, Siam,
assembled in M. A. N.,
Works Gustavsburg.

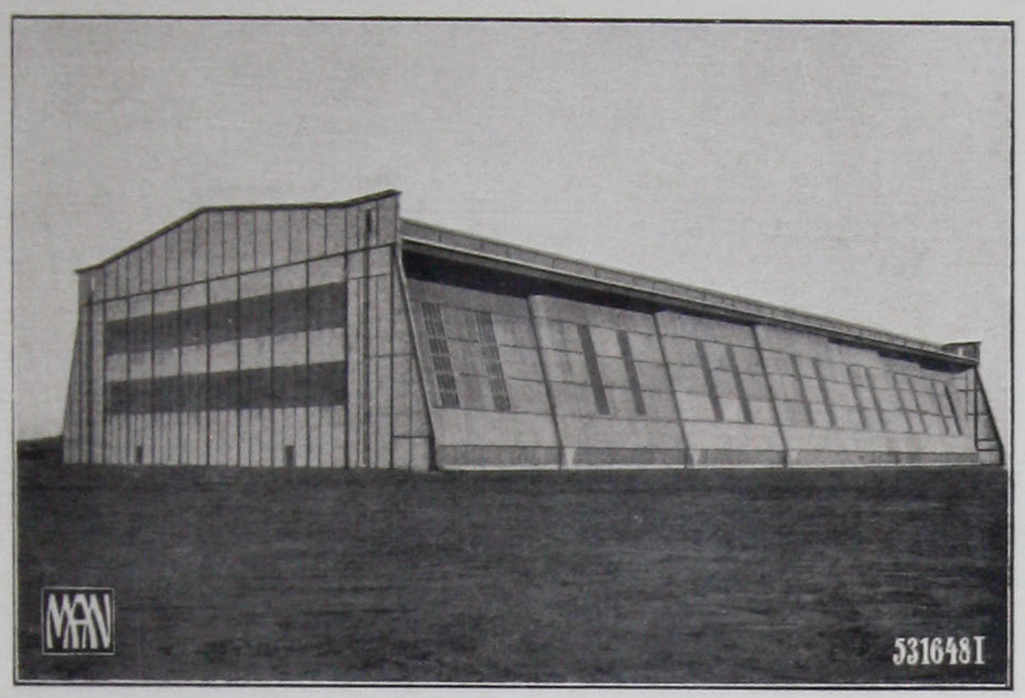


Fig. 10. Aeroplane Hangar, Warnemuende, length 459 ft., breadth 183 ft., height 60 ft.

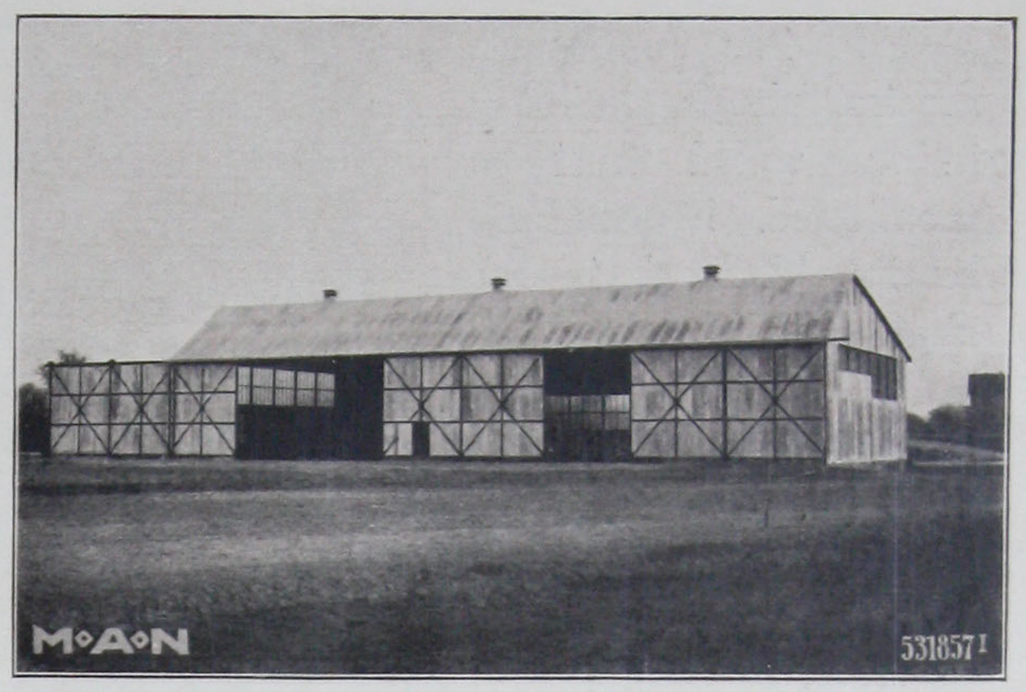


Fig. 11. Detachable Sectional Aeroplane Hangar, Mannheim.

of such heights as are now common been made possible, and simultaneously the time of erection considerably reduced. Here also the M.A.N. has executed many important contracts, for instance the offices of Mousson, Frankfurt, Knorr & Hirth, Munich, Banco Commercial, Sao Paulo etc. etc.

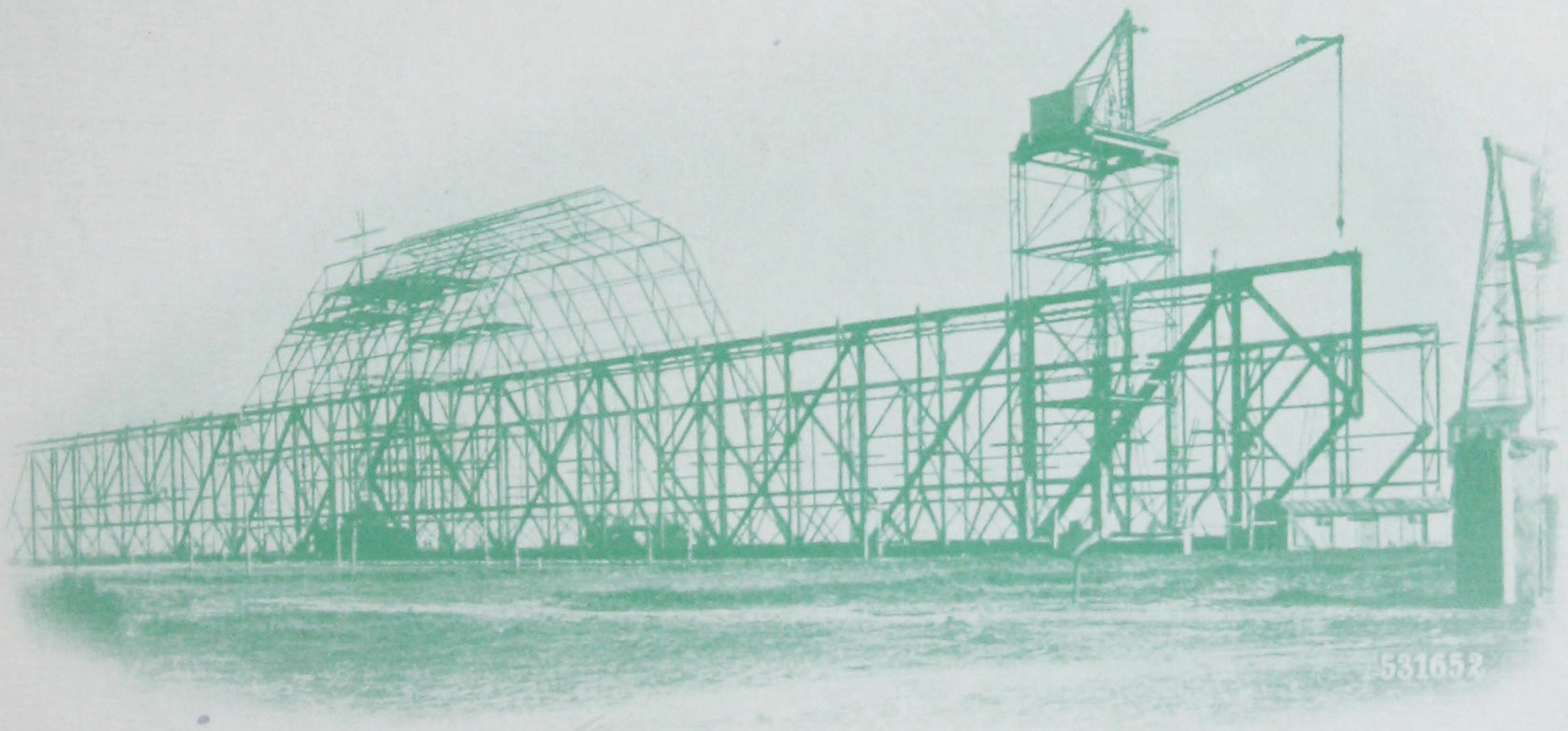


Fig. 12.
Erection of a Revolving Airship Shed.

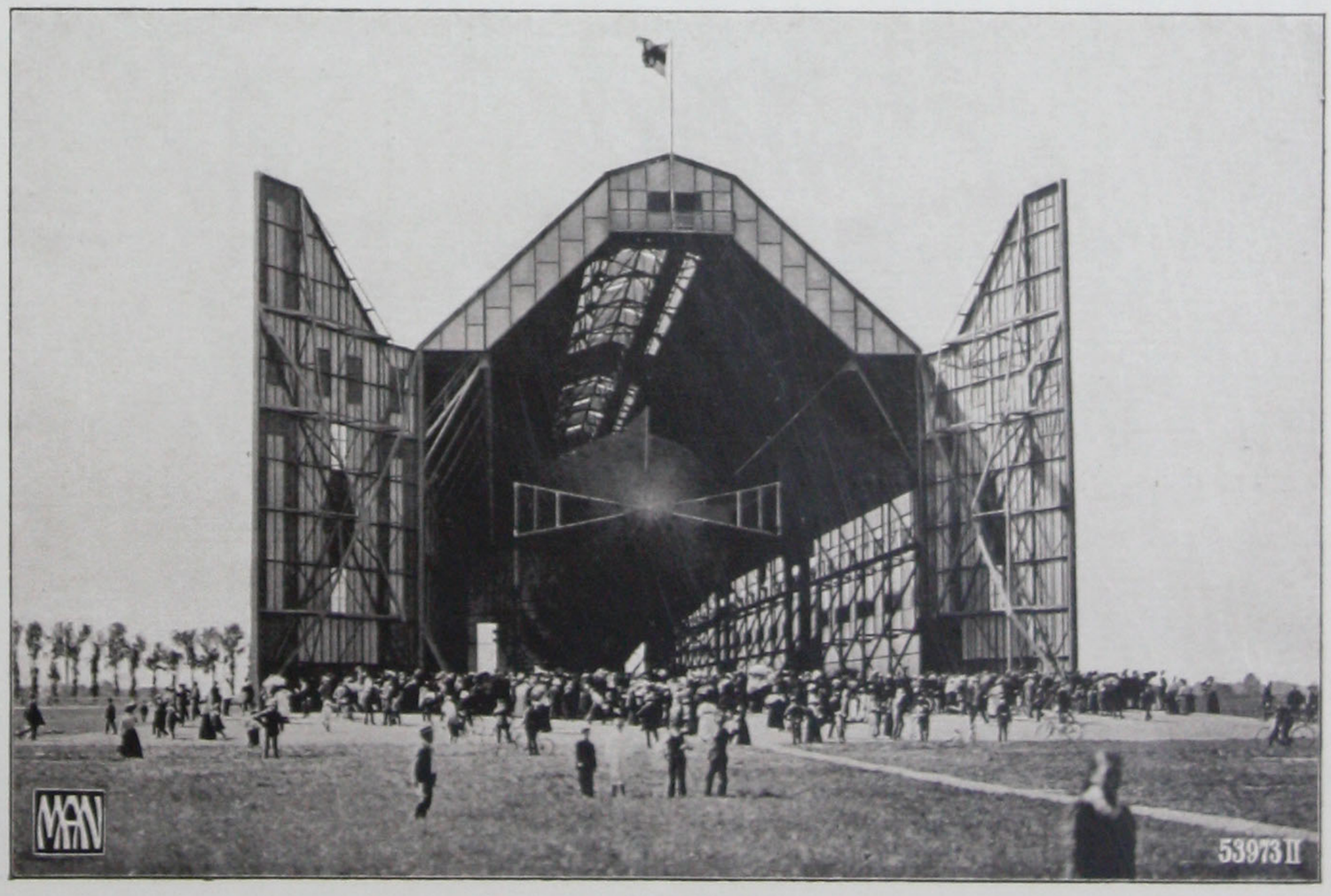


Fig. 13.
Airship Shed, Oos, near Baden-Baden.
528 ft. long, 96 ft. wide, 79 ft. high.
The complete steel structure was erected in 21 days.

In this connection the first spherical building in the world must be mentioned. This was built by the M. A. N. to the ideas of Professor Birkenholz, Munich for the Dresden Annual Fair in 1928 (ill. 16).

Workshop and Power Station Buildings.

Previously all workshops and machine halls for the heavy industries and power companies were only built to serve their purposes without

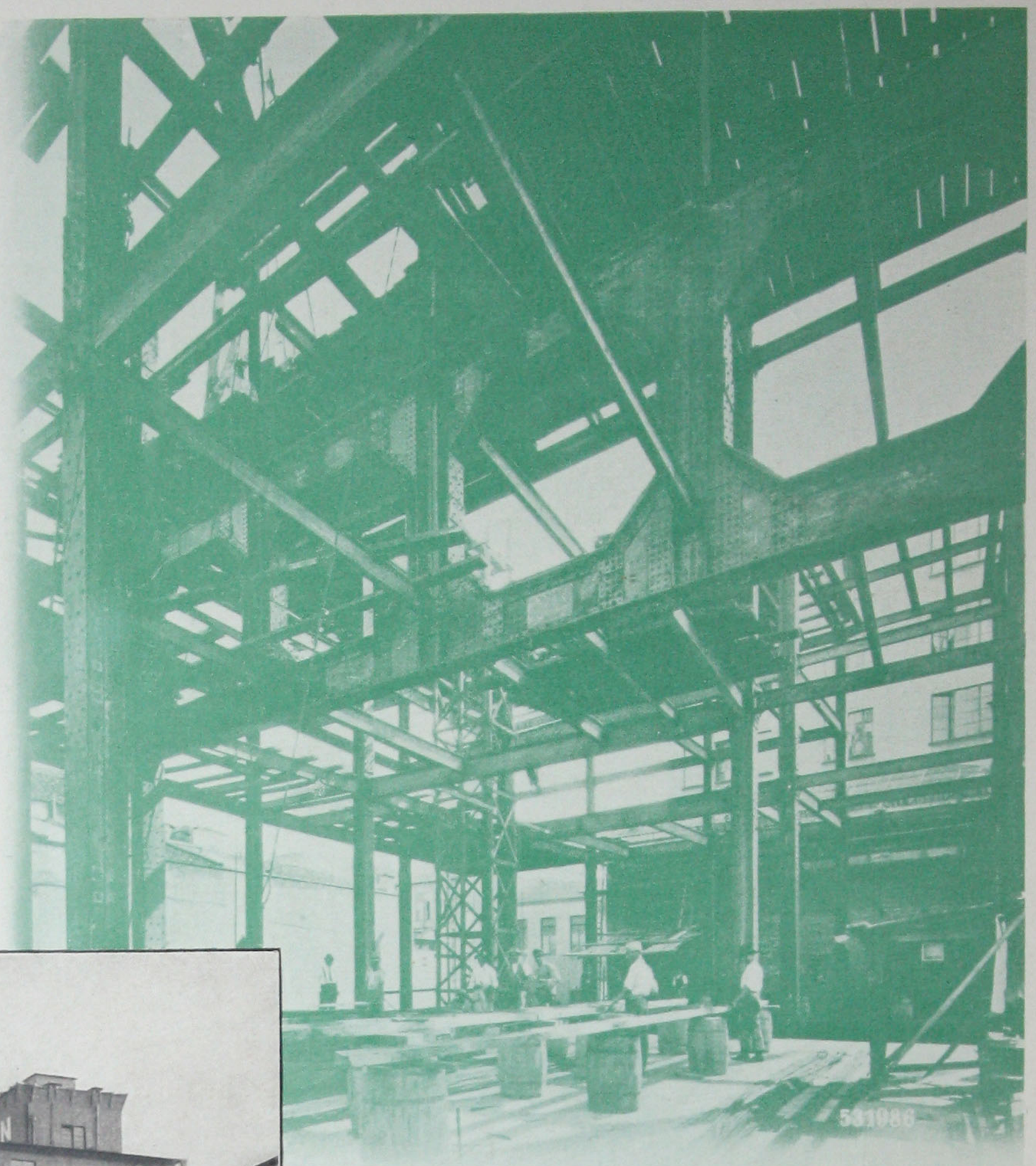


Fig. 14. Skyscraper of the Banco Commercial, Rio de Janeiro, Brazil, during erection.

Fig. 15. Skycraper for Messrs. J. G. Mousson & Co., Frankfort-on-Main.

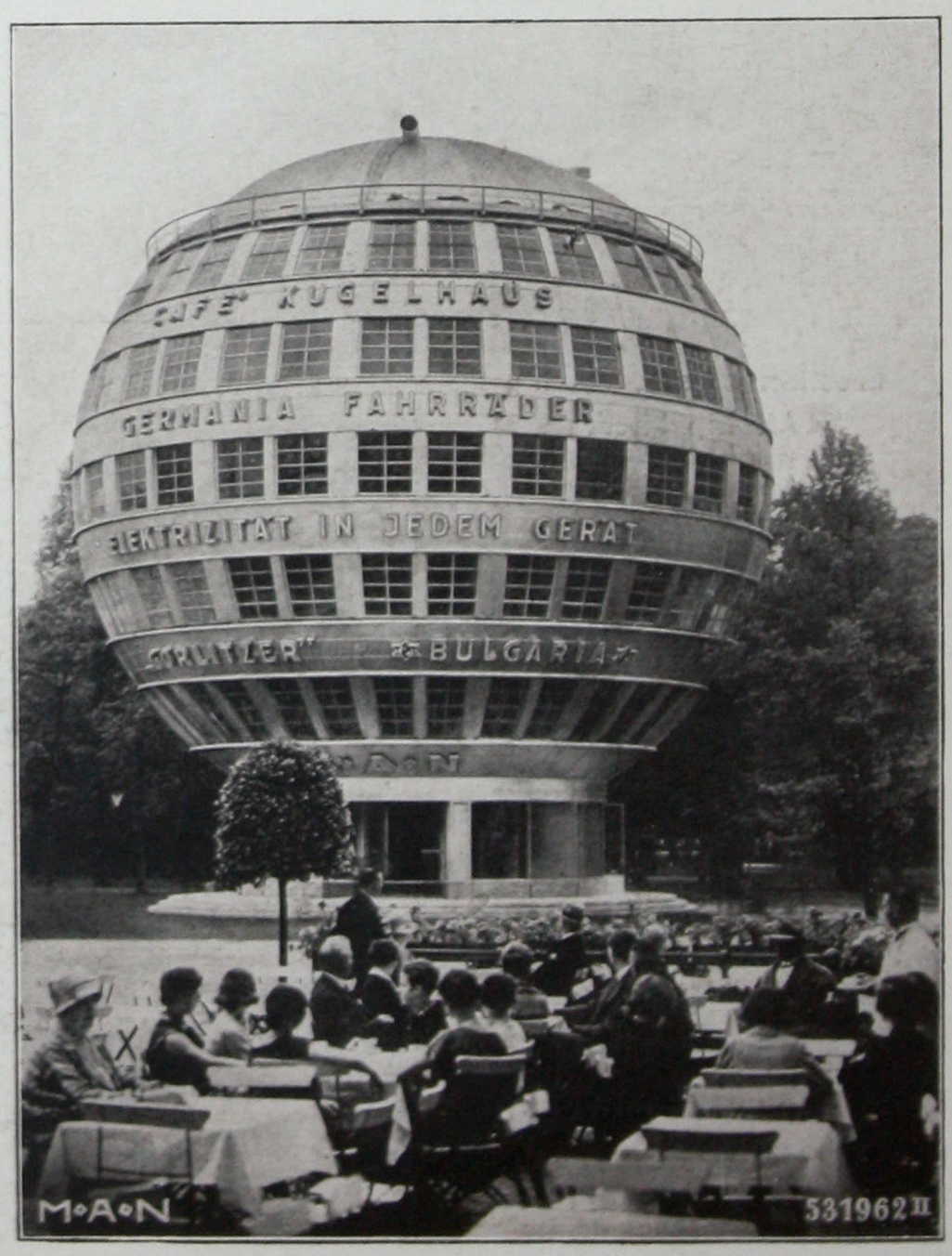


Fig. 16. First Spherical House of the World. Annual Fair, Dresden. Built in 1928.

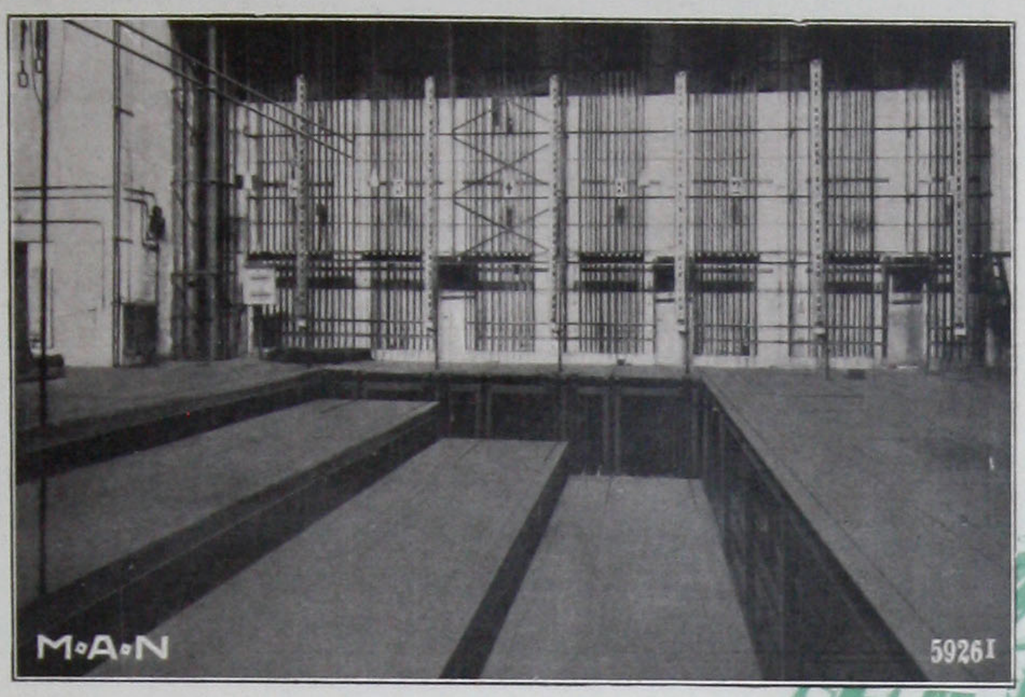


Fig. 17. Stage Equipment, Freiburg Theatre.

any attention to artistic effect. Nowadays conditions have altered, the modern industrial building harmonises with the local picture. "Gustavsburg" Buildings especially prove how the natural lines necessitated by the forces involved can also satisfy all archi-

Fig. 18. Erection of the dome of the State Theatre, Wiesbaden.

tectural requirements. The main characteristics of M.A.N. designed workshop buildings are: Securing the utmost possible uninterrupted space thus ensuring the highest efficiency for the lifting and cranage arrangements provided, water tight and temperature proof roof, safety against fire, good lighting, ventilating and heating arrangements, beauty of outer appearance and maximum internal space effect. A very good example is the steel structured hall of the Gustavsburg Southern Works which was erected in 1907.

The M.A.N. has built workshops of the largest dimensions for such different purposes as steelworks and rolling mills, foundries, machinery and structural steel workshops, for railway, tramway and chemical factories, spinning mills, weaving works, boot factories, paper works etc. In many cases M.A.N. also supplied and installed the whole conveying and heating plant.

M.A.N.'s position in the building of power stations and gas works is quite a special one. They are able to supply not only the whole structural steelwork for boiler and machine houses, stoke holds, bunkers etc. but also the power plant (steam boilers and engines or turbines, Diesel engines etc.) with all the necessary erection equipment, cranes, conveyor plant for coal, ash etc., wagon tippers and so on made in their own workshops.

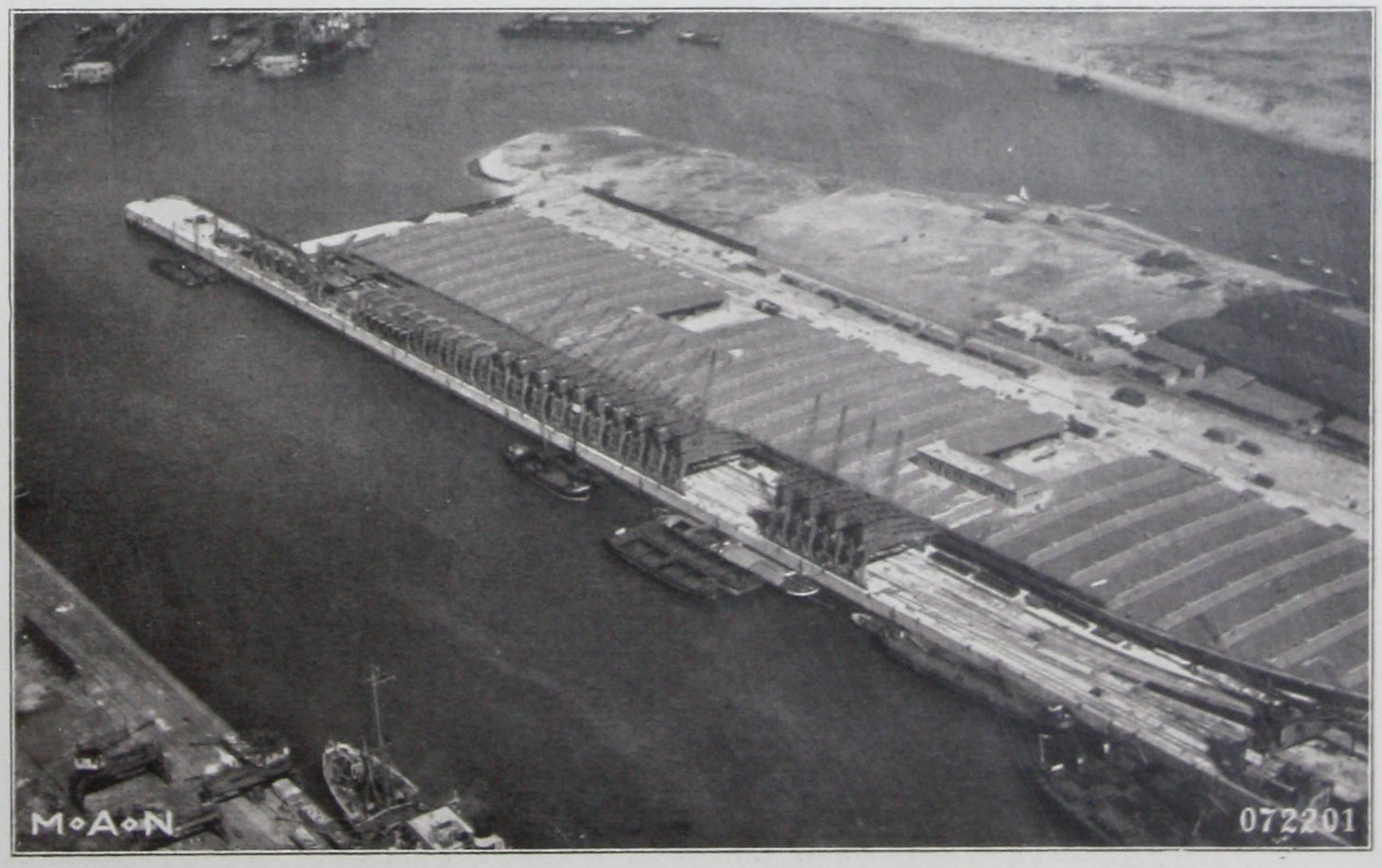


Fig. 19.
Two Cotton Warehouses, Bremen Harbour, 1260 ft. and 1299 ft. long, 216 ft. wide, with 36 Half Portal Revolving Cranes.

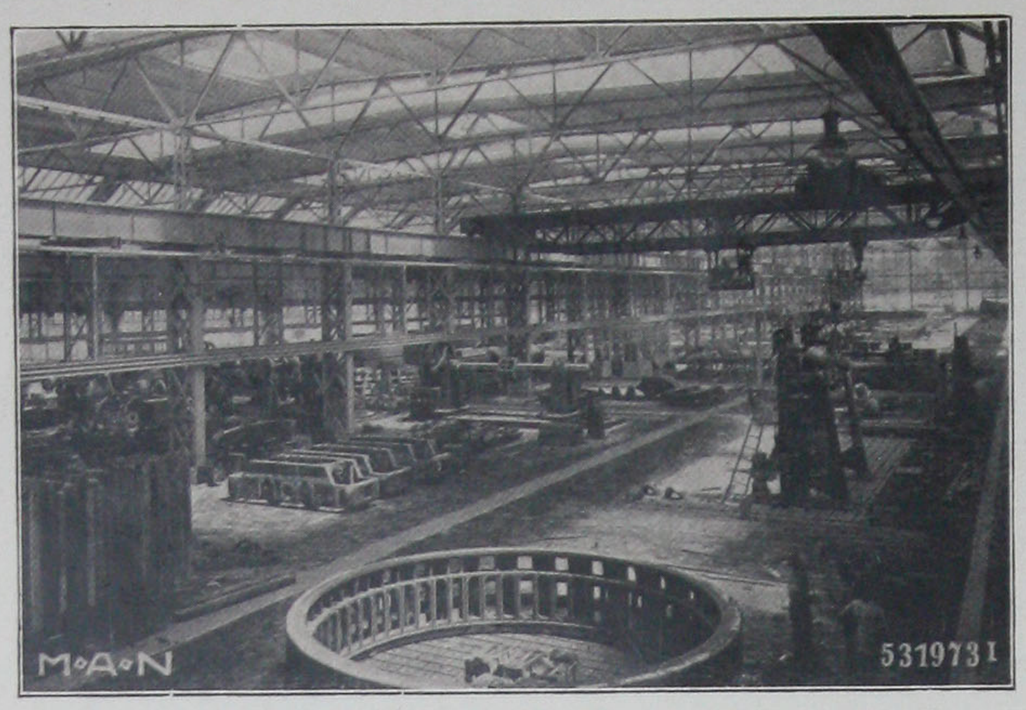


Fig. 20. Workshops of Messrs. Thomson Houston, Paris.

Fig. 21. Hemp Spinning Mill.
Deutsche Textil Werke, G. m. b. H., Wehr i. B.
Area 7,774 sq. yds. Erected in 1919/20.

Shaft and Blast Furnace Lifts.

The shaft lifts of mines and the charging conveyors of blast furnace Works need framed structures with many extensive handling devices of special design. M.A.N. pay especial attention to their lifting frames having a clean appearance, efficient arrangement of bracing and the most simple reaction of the exterior forces on the foundations. Steel structures are used for supporting the blast furnaces and also as inclined or vertical runways for the feeding conveyors. M.A.N. followed new and quite individual lines in developing feeding frames and have produced a very advantageous and reliable design. The new vertical lifts were introduced by M.A.N. and the first was erected at the Georgs-Marien Steel Works, Osnabrueck for a large plant of 5 blast furnaces. The M.A.N. also made the corresponding air and gas pipe lines, throat stopper, ore and coke conveying plant etc.

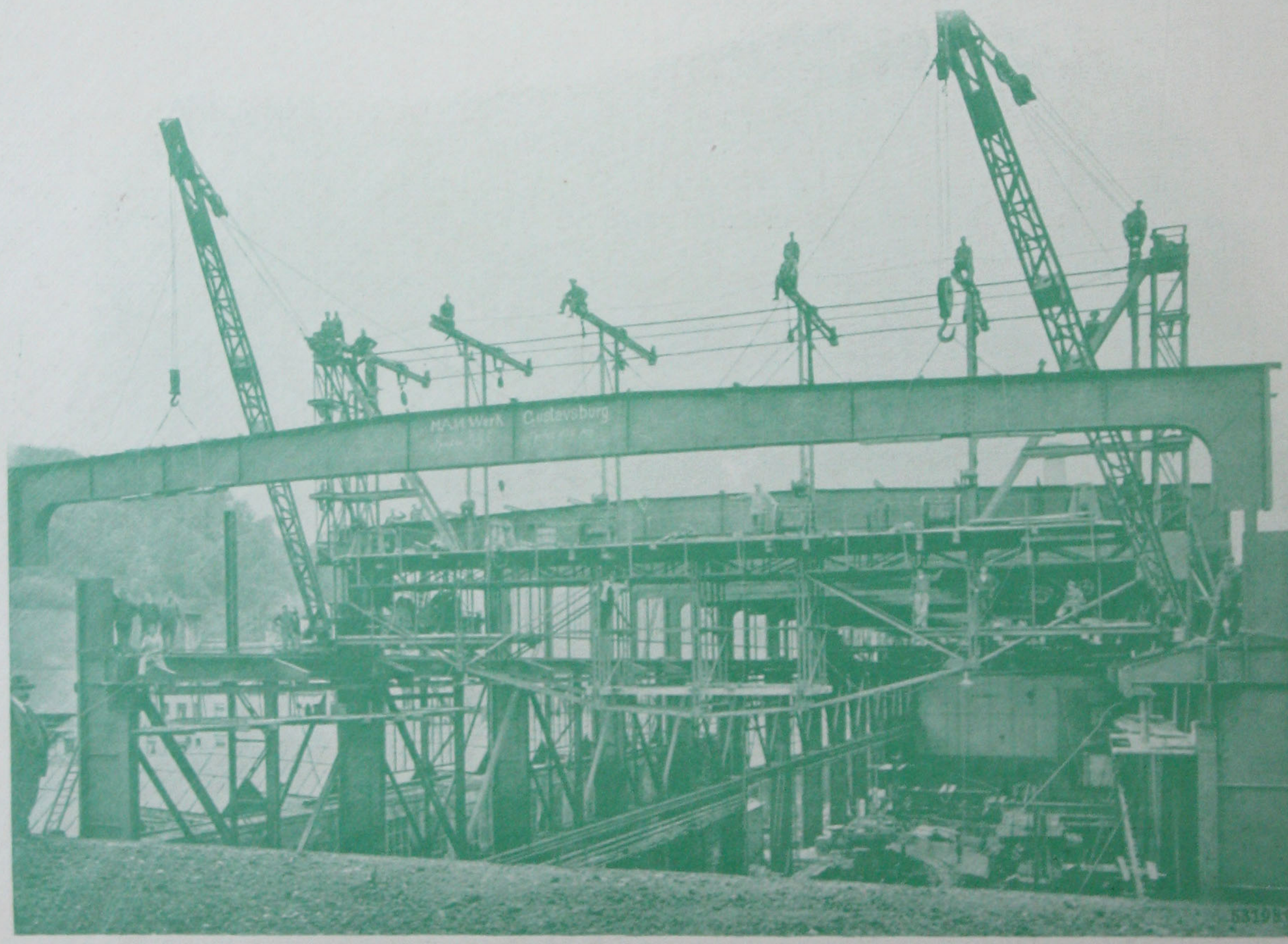


Fig. 22. Erection of a Workshop for Messrs. Brown, Boveri & Co., Baden, Switzerland.

Plant for the Shipbuilding Industry.

The M.A.N. introduced a new type of ship building berth for Germany, which was erected at the Vulcan Works in Stettin and weighed 3600 tons. A further slipway was supplied to the J. C. Tecklenborg in Geestemuende. This presented special difficulties in designing to allow for erection whilst the yard was working. Another design (patented by M.A.N.) is a frame consisting of only one support surmounted by a rotating girder crane serving every two adjoining

Fig. 23.
Engine house of the large Power Station at Mannheim, during erection.

Fig. 24. Railway Main Repairing Shop, Delitzsch.

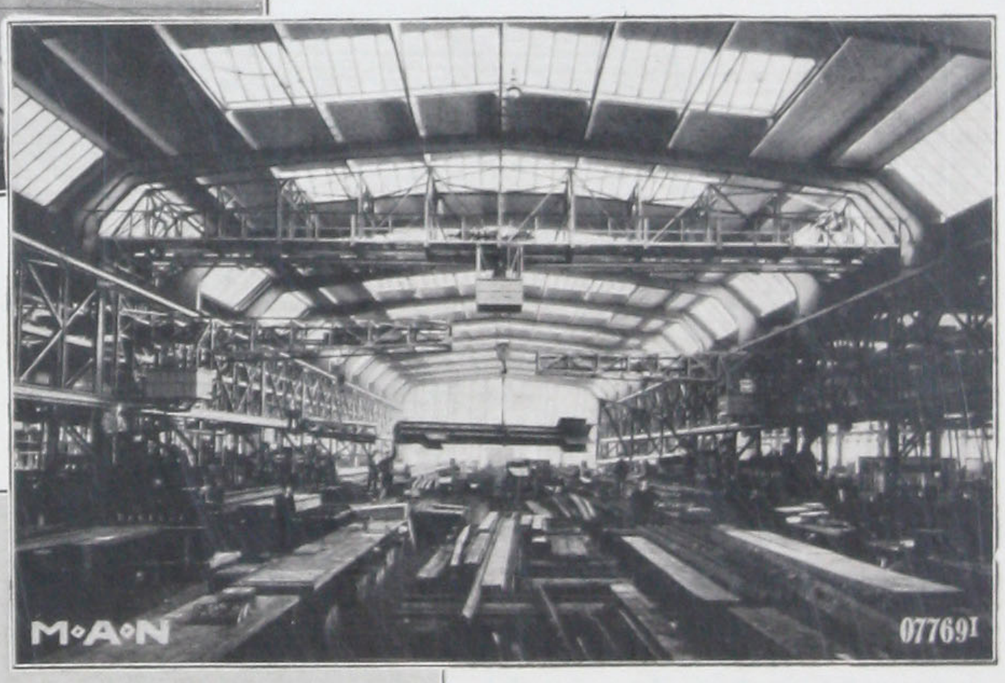


Fig. 25.
Southern Works of the M. A. N. Gustavsburg.
Erected in 1907.

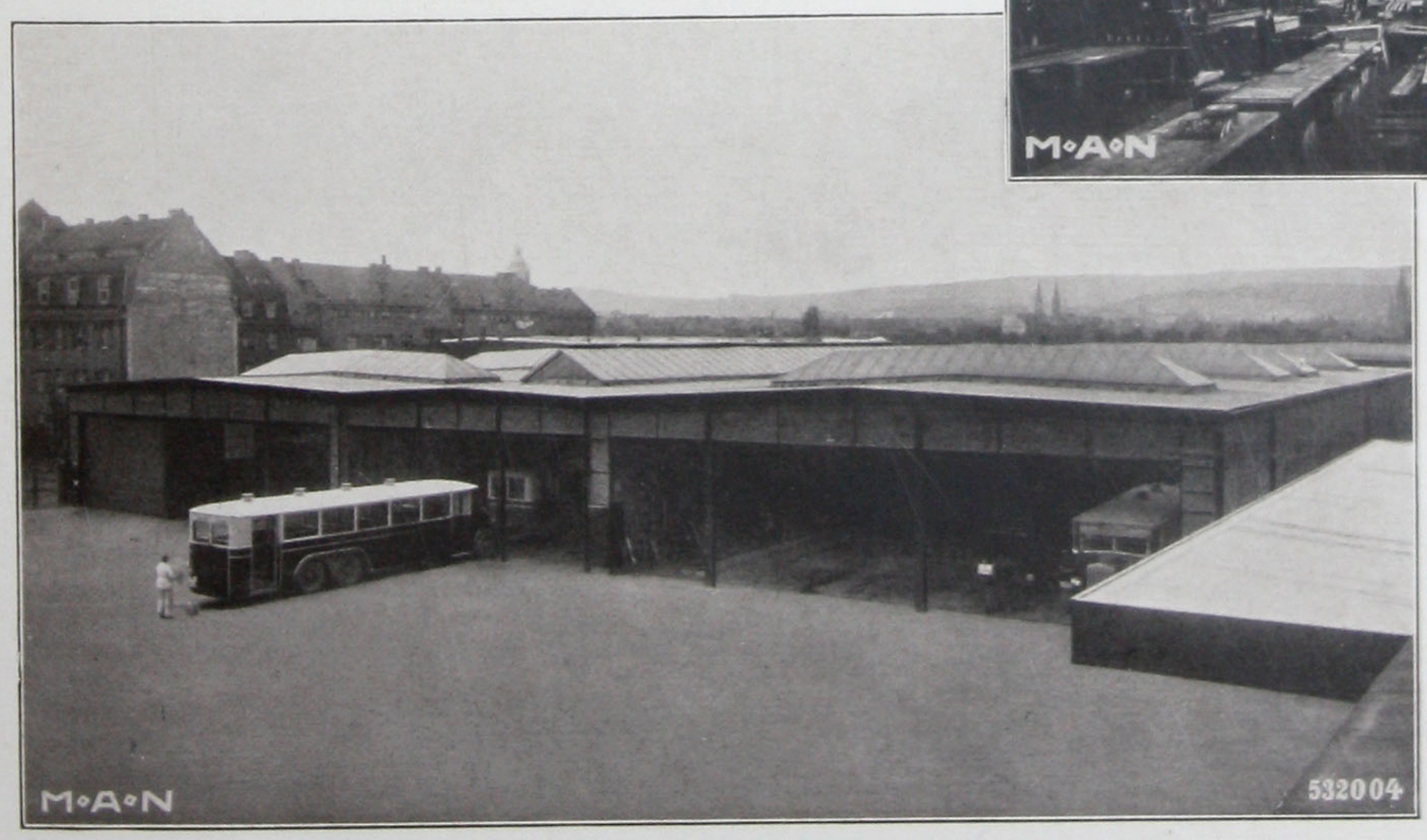


Fig. 26.
Omnibus Garage, Wiesbaden.

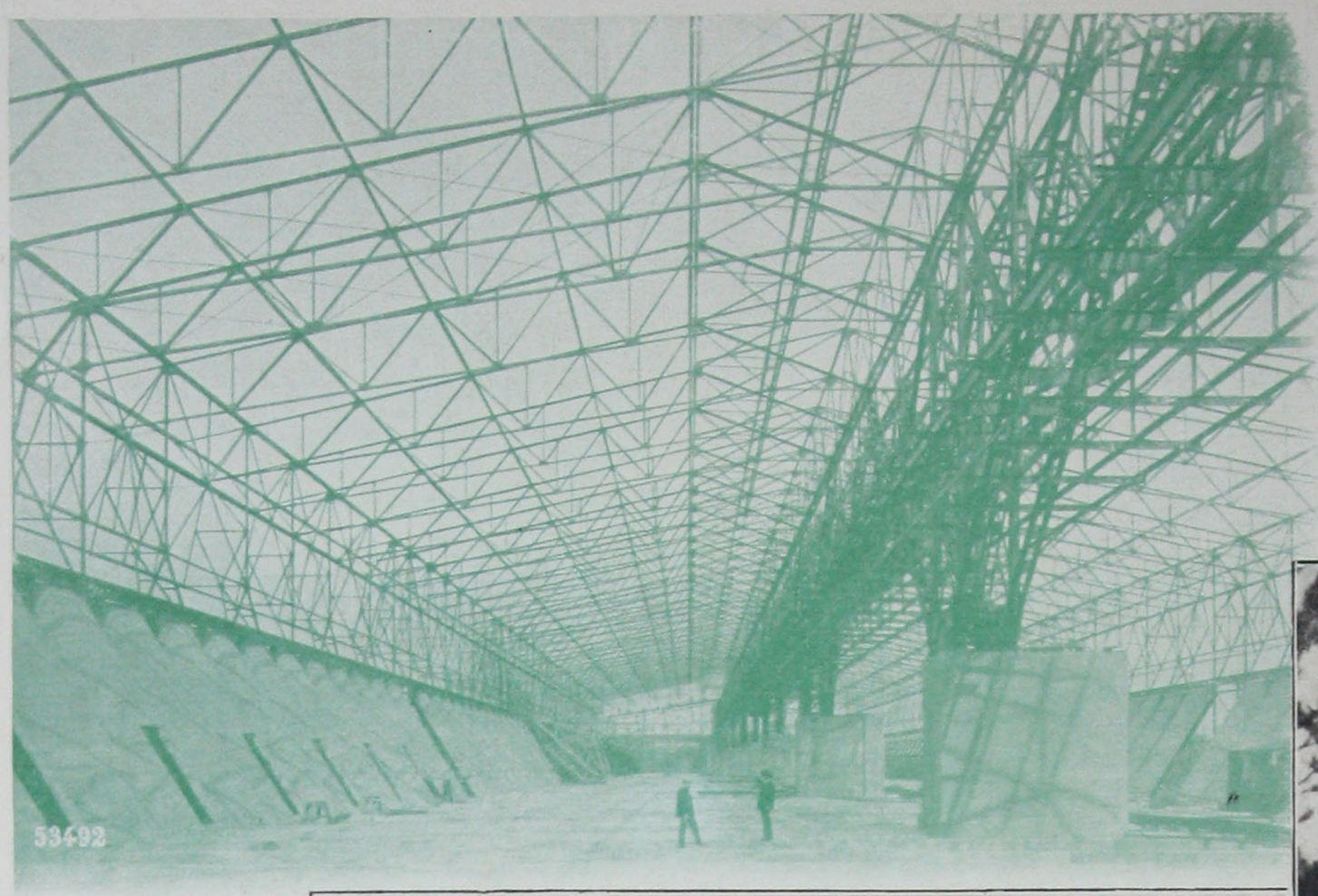
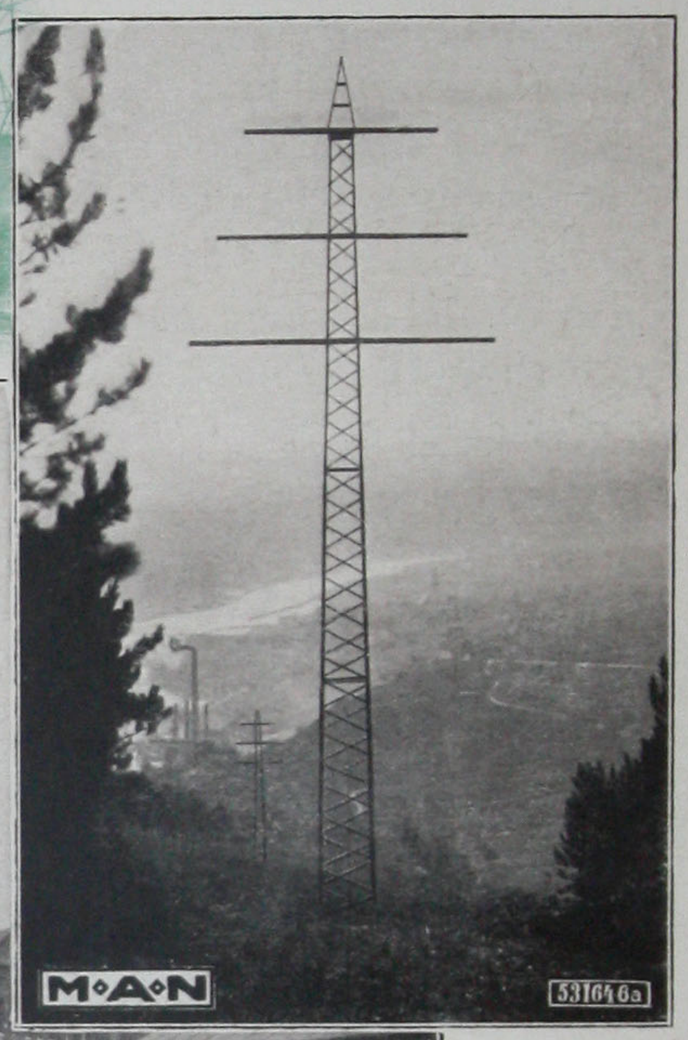


Fig. 27. Coal Store of Gasworks No. VI at Berlin-Tegel during erection, height 92 ft., width 167 ft., length 1,883 ft., capacity: 170,000 tons of coal.

Fig. 28. Braced Steel Mast for 100,000 volt transmission line of the Bayern Werk A.-G. Height 93 ft.



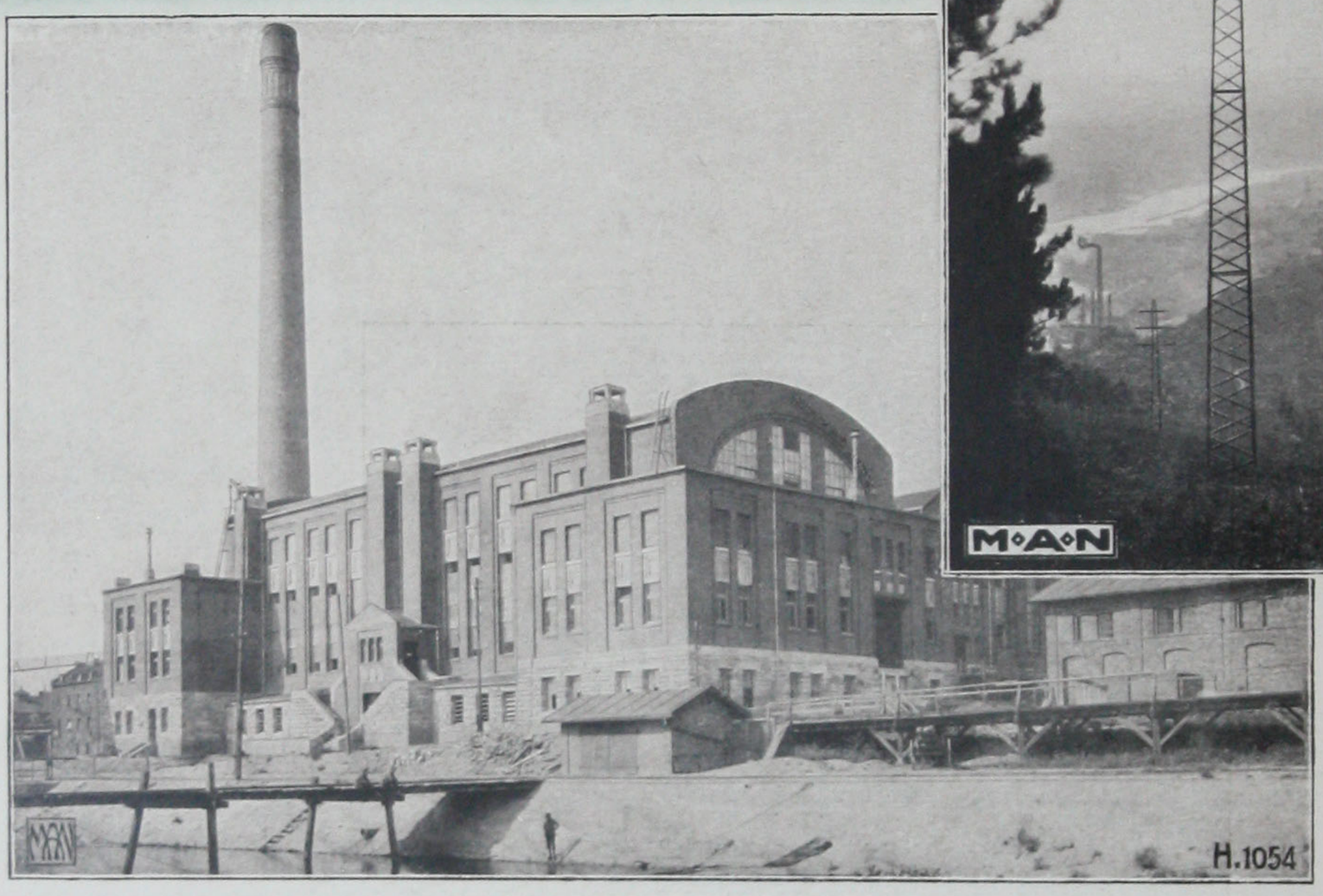


Fig. 29. Power Station of Messrs. Dyckerhoff & Söhne, G. m. b. H., Portlandzementfabrik, Amoeneburg.

building berths. In this way the outer row of columns is avoided and on the other hand wider ships can be built on the same space. The M. A. N. also build complete river berths, dry and floating docks and inclined slipways for ship repairing yards.

Fig. 30. Radio Broadcasting Tower, Las Salinas, Chile.

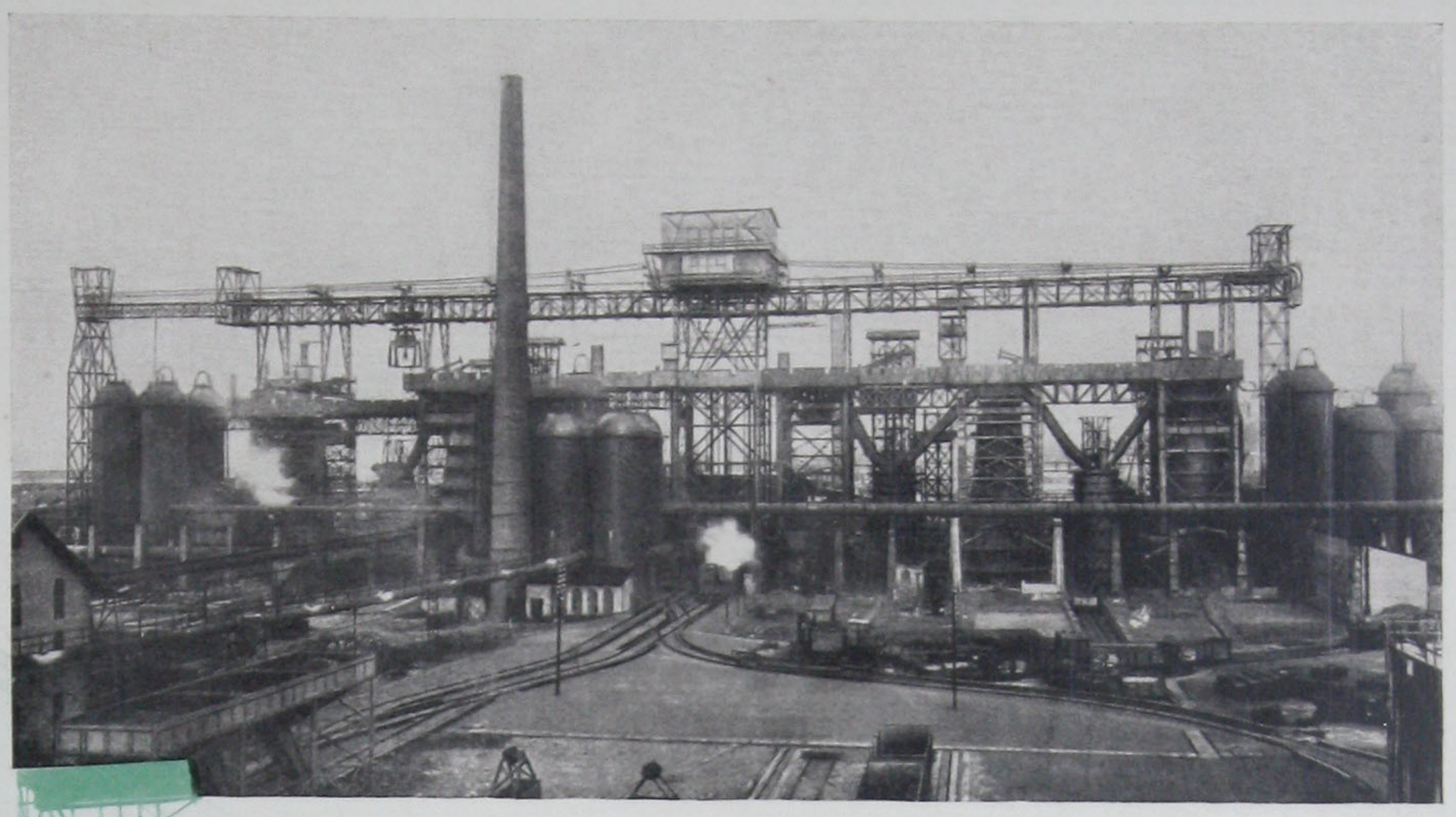


Fig. 31. M.A.N. vertical lift for Blast Furnaces.
Georgs-Marien-Bergwerks- und Hüttenverein, Osnabrueck.

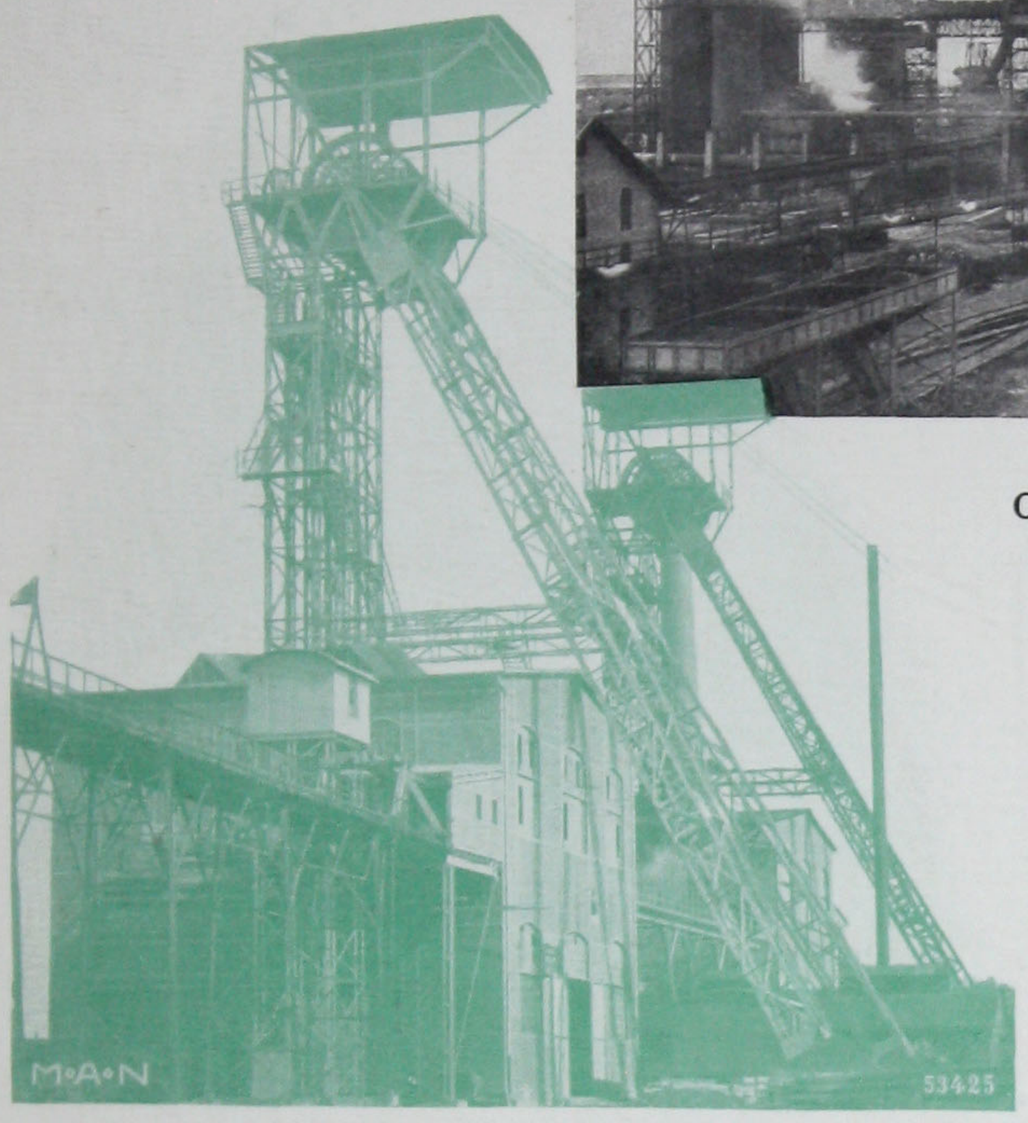


Fig. 32. Two Pithead Frames, Zeche Matthias Stinnes, Essen.
Height of the Rope Drum 131 ft. above the ground.

Holders.

Gasholders and storage tanks for liquids fall within the category of steel structures. The Waterless Gasholder of the M. A. N. has completely altered previous conditions with Telescopic Holders. The very heavy and expensive water tank is avoided. A piston rises and falls inside the totally enclosed shell thus providing the necessary storage in the Holder. A gas tight joint between piston and shell is formed by means of a liquid seal, for instance, tar, as this needs no heating in winter. The M.A.N. holders are very popular owing to their manifold advantages, viz, high reliability, small ground loads, low upkeep costs. Up to now holders for more than 570 millions cu. ft. capacity have been erected in all parts of the World. Amongst them are the largest holders in the World with 20,000,000 cu. ft. and 15,000,000 cu. ft. capacity.

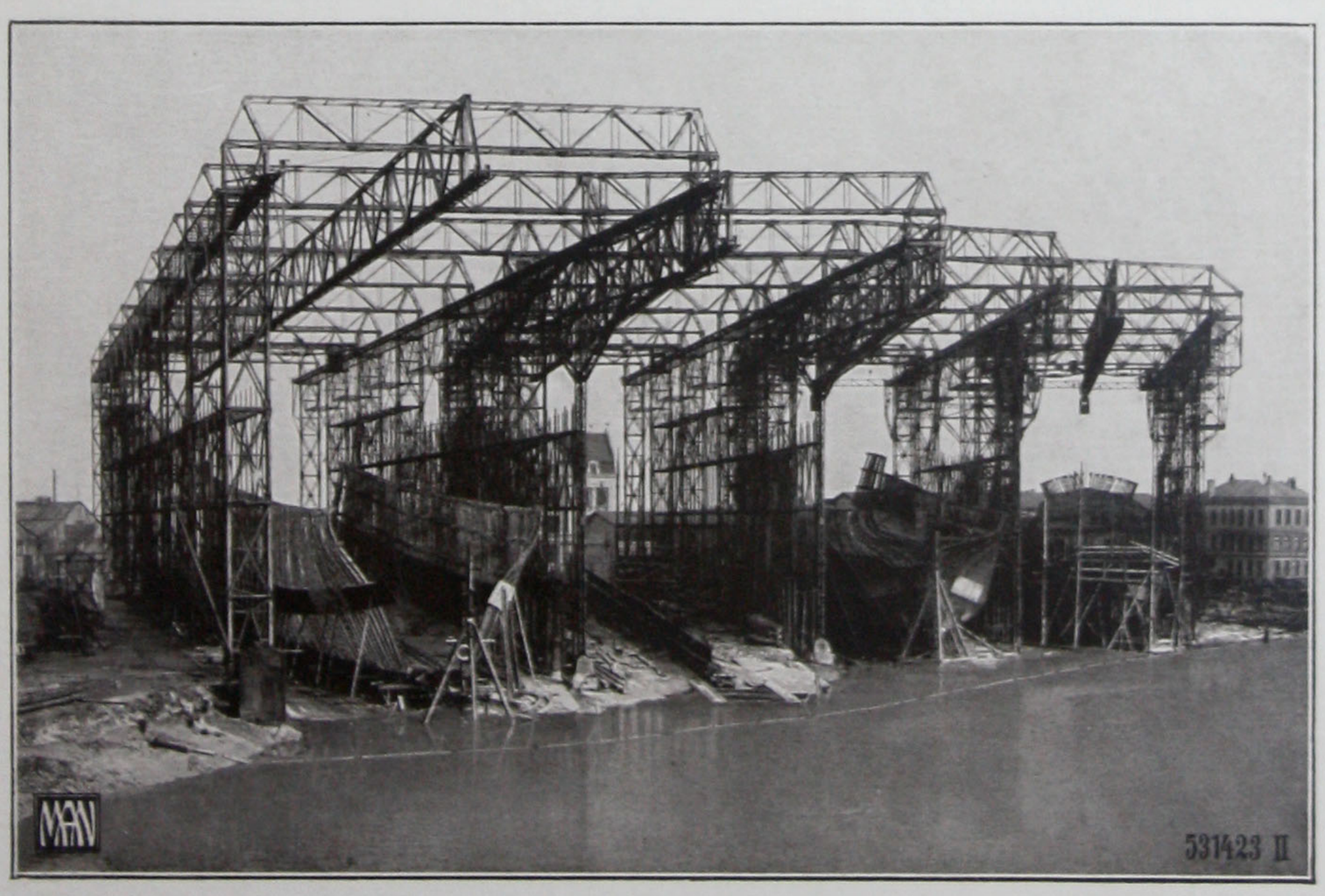


Fig. 33. Shipbuilding Berth,
J. C. Tecklenborg A. G.,
Geestemuende.
2,880 tons of steelwork.
Erected in 1906/07 whilst the yard was working. Extended in 1913 and 1917/18.

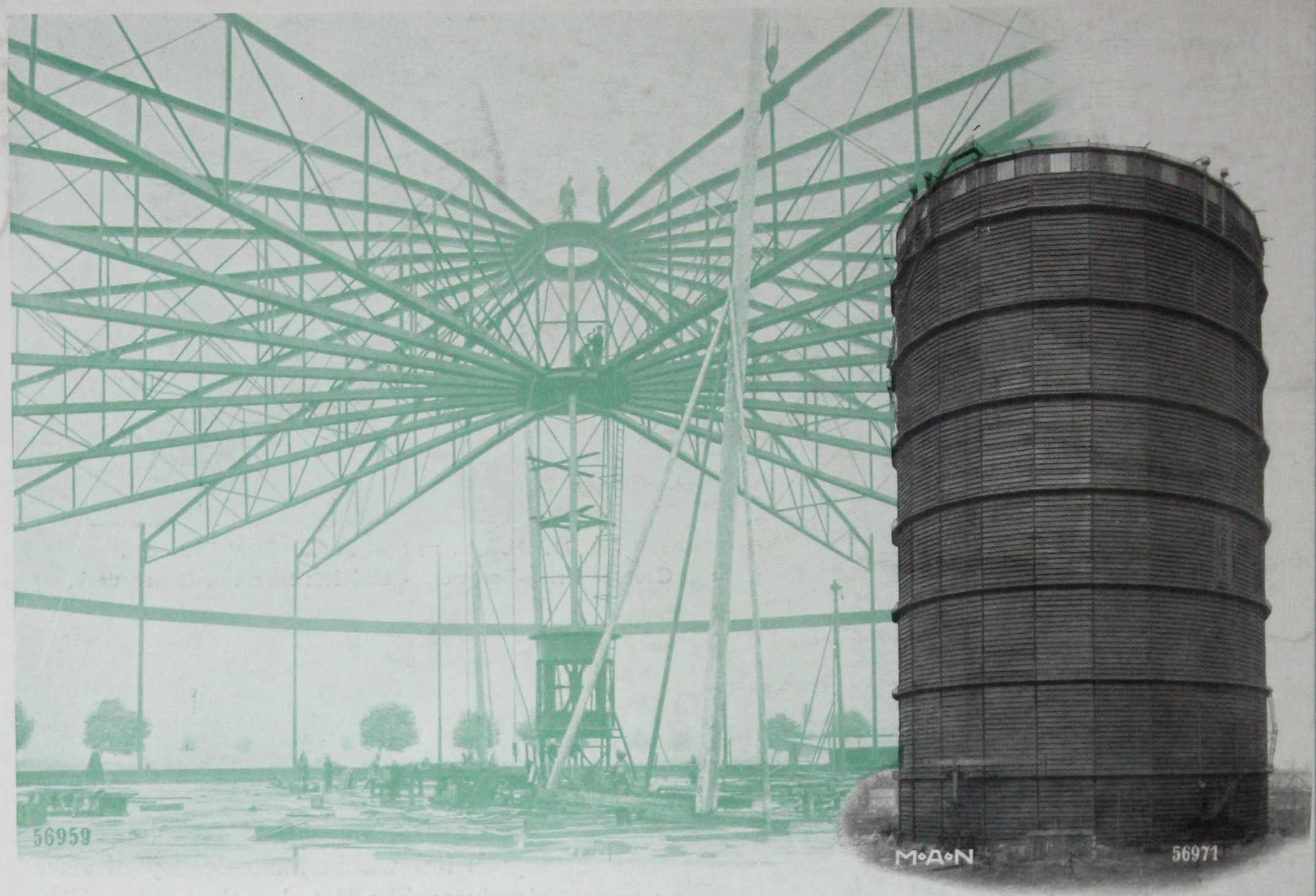


Fig. 35. Erection of an M.A.N. Waterless Gasholder.

Fig. 34. M.A.N. Waterless Gasholder, capacity 12,500,000 cu. ft. Gutehoffnungshuette Oberhausen A.G. Largest Gasholder in Europe.

The M.A.N. has also made tanks, bunkers and hoppers of all kinds, for the storage of various liquids, coal, coke etc.

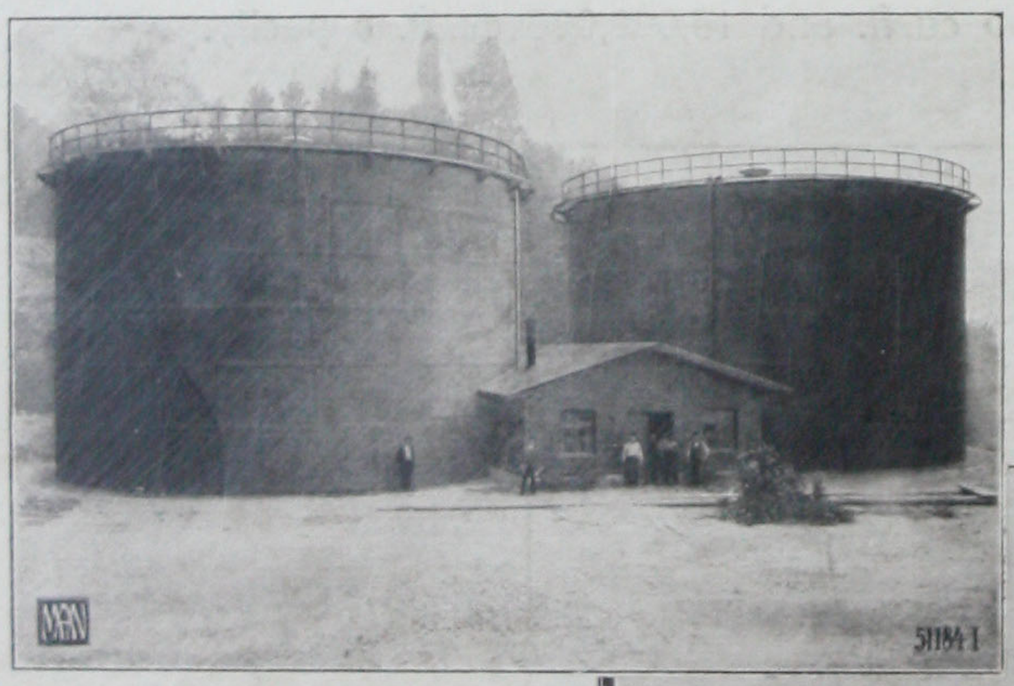


Fig. 36. Two Oil Holders each of 70,000 cu. ft. capacity. Haidar Pascha Harbour.

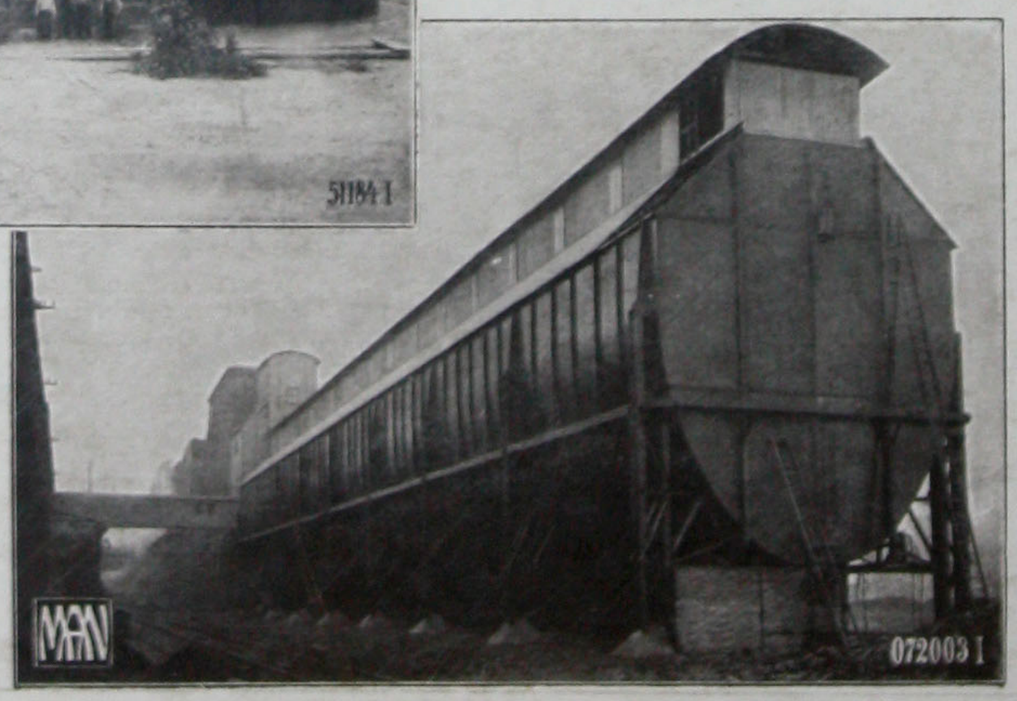


Fig. 37. Coal Bunker to M.A.N. Design. Rombacher Huettenwerke, Rombach i. Lothr.